# CHAPTER II.4. COST OF KIDNEY CANCER

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# CHAPTER II.4. COST OF KIDNEY CANCER

## II.4.A Background

This chapter contains a discussion of the methods used and results of estimating the direct medical costs incurred by kidney cancer patients. It does not include information on elements such as indirect medical costs, pain and suffering, lost time of unpaid caregivers, etc. The reader is referred to Chapter I.1 for a discussion of the cost estimation methods and cost elements that are relevant to all benefits estimates. In addition, Chapter II.1 contains information regarding cancer causality, a list of known and suspected carcinogens, and information on cancer cost estimation.

The costs presented in this chapter were current in the year the chapter was written. They can be updated using inflation factors accessible by clicking on the sidebar at left.

*Link to Chapters I.1 and II.1*
*Link to inflation factors*

### II.4.A.1 Description

Kidney cancer is a malignancy within the kidneys and may be localized or have spread to multiple sites (Bennet and Plum 1996). It represents one to three percent of all adult cancers in the United States (Javadpour 1984, Klein et al., 1993). Kidney cancer occurs most frequently in individuals in their fifties through seventies, with two to three times as many males as females developing the disease (NCI 1994, Javadpour 1984, Klein et al., 1993, Montie et al., 1990). Approximately 25,300 new cases of kidney cancer were diagnosed in 1991 in the U.S. (NCI 1994).

According to the National Cancer Institute (NCI 1994), the incidence of kidney cancer in the U.S. has increased by over 30 percent over the past 20 years, from a rate of 6.7 per 100,000 in 1973 to 8.8 per 100,00 in 1991. Although this increase may be attributed in part to improved detection techniques, a concurrent rise in mortality due to kidney cancer indicates that there has been a real increase in disease incidence in the U.S. over time (McCredie 1994). Reported rates of kidney cancer incidence and mortality have increased worldwide in the past decades, particularly in more industrialized countries. According to McCredie (1994), kidney cancer is likely to become the most common urinary cancer in the coming decades, and one of the major cancers of affluent societies, unless its etiology can be better identified and addressed.

### II.4.A.2 Concurrent Effects

No data were located indicating that concurrent effects unrelated to kidney cancer or its treatment were likely to occur with this disease. Secondary cancers and other adverse health effects may occur due to treatment and therapy. These can incur added medical costs not considered in this chapter.

### II.4.A.3 Causality

Carcinogens suspected of causing renal cancer in human study groups include hormones, radiation, certain viruses, tobacco smoking, phenacetin-containing analgesics, paracetamol, obesity and hypertension (or drugs used for their treatment), asbestos, and renal injury (Javadpour 1984, McCredie 1994). Kidney cancer has been induced in experimental animals via exposure to chemical, physical, viral, and hormonal agents; radiation; and dietary deficiencies (Konishi et al., 1994, Javadpour 1984). Epidemiological data show significantly greater frequencies of kidney cancer in cigar smokers, smokers with occupational exposures to cadmium, petroleum industry workers, and possibly workers with occupational exposures to lead. Kidney toxins, such as unleaded gasoline, have demonstrated carcinogenic potential in chronic bioassays in animals (Konishi et al., 1994). Other risk factors appear to be linked to a more affluent lifestyle, including diet; and perhaps to increasing industrial exposure in some localities (McCredie 1994). As is often the case with cancers, however, it is difficult to prove causality. McCredie (1994), for example, hypothesizes that the general effect of changes in standard of living is a significant cause of the increased incidence of kidney cancer.

Table II.1-1 in Chapter II.1 contains a list of chemicals known to cause or suspected of causing cancer (as reported in the EPA databases IRIS, HEAST, and HSDB). Most chemicals in the table were carcinogenic in animal studies. These studies do not provide organ-specific data because it is not generally assumed that cancer induction will always occur at the same site in humans as in animals. Consequently, the chemicals listed in Table II-1 may cause kidney cancer and/or other types of cancer. Evaluation of the likelihood of this occurrence would require additional research (risk assessment).

*Link to Table II.I-1*

### II.4.A.4 Treatments and Services

Kidney cancer is slow to develop, and may reach relatively advanced stages before detection. Symptoms may include fever, weight loss, generalized weakness, abdominal pain, abnormal increases in red blood cells or blood calcium levels, anemia, bloody urine, cardiac enlargement, or liver dysfunction without evidence of liver cancer. Advances in diagnostic techniques, such as bone scanning, chest tomography, computed tomography (CT), ultrasonography, and magnetic resonance imaging (MRI) have greatly improved the diagnosis of kidney cancer, though have not yet increased survival rates (Javadpour, 1984).

The only effective therapy for kidney cancer is surgical excision (often involving removal of the kidney, adrenal gland, associated fat, and regional lymph nodes) before it has a chance to spread to other organs or metastasize to distant sites in the body (Javadpour 1984, Klein et al., 1993). Chemotherapy, radiotherapy, and hormone therapy have all proven ineffective as a systemic treatment for kidney cancer. Immunotherapy (also known as biologic response modifier (BRM) therapy), though still experimental, may prove valuable in treating advanced kidney cancer (Klein et al., 1993, Montie et al., 1990).

### II.4.A.5 Prognosis

Overall, the five-year survival rate in the U.S. for all kidney cancer patients is only about 54 percent (McCredie 1994) and the six-year survival is approximately 50 percent (NCI, 1998, based on patients diagnosed in 1987). Kidney cancer can and does metastasize to most areas of the body, most commonly the lymph nodes, lungs, liver, and bones (Montie et al., 1990). More than half of all new patients are diagnosed with regionally advanced or metastatic kidney cancer (Klein et al., 1993). Although kidney cancer can include spontaneous regressions and long survival in the presence of metastatic disease, there is currently no effective treatment of metastatic kidney cancer, and prognosis for these patients is very poor (Javadpour 1984, Montie et al., 1990). Patients with advanced kidney cancer face a median survival of ten months and a one to two percent chance of surviving five years or more (Klein et al., 1993).

## II.4.B. Costs of Treatment and Services

### II.4.B.1 Methodology

This chapter estimates the per-patient lifetime direct medical costs of treating kidney cancer based on the work of Baker et al. (1989 and 1991). Baker et al. used the Continuous Medicare History Sample File (CMHSF) to estimate average per-patient medical costs of treating kidney cancer. They chose CMHSF because: (1) it is a nationally representative sample of

the Medicare population (5 percent), covering over 1.6 million patients; (2) it is longitudinal, dating from 1974 to 1981; and (3) it captures the majority of medical expenses for each beneficiary.

Five Medicare files are included in the CMHSF, which cover:

1) inpatient hospital stays,
2) skilled nursing facility stays,
3) home health agency charges,
4) physician services, and
5) outpatient and other medical services.[1]

Baker et al. calculated the average medical costs of Medicare patients with kidney cancer, as well as the average medical costs of a randomly-selected sample of Medicare patients without cancer (i.e., baseline costs). To estimate costs attributable to kidney cancer, this report subtracts baseline costs from the costs of patients with kidney cancer. An alternative approach would have been to examine the medical services used by patients with kidney cancer and make judgments, based on the nature of each service, about whether its use was attributable to kidney cancer. This second method is more complicated and requires that the motivation for medical services be inferred.

Because CMHSF provides no indication of initial diagnosis, Baker et al. assumed that a kidney cancer diagnosis appearing on a hospitalization record after a minimum of one year without a kidney cancer diagnosis indicated disease onset. This assumption would seem to hold true for a majority of cases because of the high frequency of surgery and hospitalization associated with initial treatment of kidney cancer (Klein et al., 1993). Only patients with an initial diagnosis during the years covered by the database were included.

The number of Medicare beneficiaries included in the kidney cancer subset of the CMHSF, as defined by Baker et al., was 1,953. The random subset of non-cancer patients, called the "co-morbidity subset" by the authors, consisted of every 16th beneficiary contained in the CMHSF who had not been hospitalized for cancer. Given that the CMHSF database contains approximately 1.6 million accounts, the co-morbidity subset represents about 100,000 individuals.

Baker et al. estimated total costs associated with three phases of treatment:

[1] See Baker et al., 1991 for further details.

*Initial:* all costs appearing on a beneficiary's record for up to three months following diagnosis;

*Terminal:* all costs appearing on a beneficiary's record within six months of death; and

*Maintenance (intermediate phase):* all costs incurred between these two periods (calculated as an average monthly cost).

These periods differ significantly in intensity and cost of related medical care. Initial therapy generally includes intensive diagnostic testing and surgical removal of the tumor, incurring very high medical costs over the approximately three months following initial diagnosis. If this treatment is successful, a cancer patient will undergo a period of remission, during which little medical treatment is given apart from monitoring for potential cancer recurrence.

For the approximately fifty percent (NCI 1994) of patients who eventually die of kidney cancer, a third phase of intensive terminal care (involving further surgery, radiation, and/or other measures to alleviate symptoms) takes place over approximately the last six months of their lives, which again incurs substantial medical costs. According to Baker et al., the pattern of initial, maintenance, and terminal care treatment phases is apparently little affected by differences in total survival time of the patient; the major difference is in the length of the maintenance phase (Baker et al., 1991). Because Baker et al. (1989) calculated *monthly* maintenance phase costs but not the duration of the maintenance phase, this report calculates average *lifetime* maintenance phase costs based on survival rate data.

Baker et al. made four adjustments to the cost estimates calculated from the CMHSF. First, they added charges for skilled nursing facilities (SNFs) that were not covered by Medicare by multiplying the "length of stay" at an SNF (computed from admission and discharge dates) by the average daily SNF charge.[2] Second, they added the annual Medicare Part B deductible of $60 to the reimbursed charges in the database. Third, since Medicare only pays 80 percent of physicians' charges, they scaled these reimbursements up to 100 percent of physician charges to better reflect social costs. Finally, they inflated all dollar values to 1984 dollars using the Medical Care component of the Consumer Price Index.

[2] Where no discharge date was given, Dec 31, 1981 (the end of the file) was used as the discharge date. This likely underestimates SNF stays and therefore overall costs for some patients.

## II.4.B.2 Results

### *II.4.B.2.1 Treatment Phase Costs*

Costs were estimated for each treatment phase, using the methodology described above for Baker et al. Their cost estimates are given in 1984 dollars. Table II.4-1 shows average undiscounted total (non-incremental) charges incurred over the three phases of kidney cancer treatment. The comorbidity charges corresponding to the duration of each treatment period are also listed.

**Table II.4-1**
**Average Patient Charges Per Treatment Phase of Kidney Cancer, in 1984 dollars**

| | Kidney cancer treatment charges | Co-morbidity charges[a] |
|---|---|---|
| Initial (Total Over 3 Months) | $12,608 | $747 |
| Maintenance (Average per Minth) | $670 | $249 |
| Terminal (Total Over 6 Months) | $19,302 | $1,494 |

Source: Baker, et al., 1989 and 1991 (for background costs).
[a] From Baker et al. (1991) This is the average cost of medical care for patients not undergoing treatment for cancer.

Table II.4-1 also includes co-morbidity charges (i.e., baseline charges) from Baker et al. (1991). Co-morbidity charges for initial, maintenance, and terminal phase treatment are $747 total, $249/month, and $1,494 total, respectively.[3] These charges are subtracted from the charges associated with kidney cancer to yield net charges for the treatment of kidney cancer.

Baker et al. (1989) provides only summary charges for each of the treatment phases; cost associated with each of the treatment components (i.e., inpatient hospital stays, skilled nursing facility stays, home health agency charges, physician services, outpatient services, and other medical services) were not listed in the report.

[3] Co-morbidity charges of $249 per month were reported in Baker et al.'s analysis of breast and lung cancer (1991). The charges represent medical costs for a random sample of the Medicare population without cancer *with age distribution matching that of the breast and lung cancer subsets*. Co-morbidity charges for a sample matching the age distribution of the population with kidney cancer may vary slightly.

### *II.4.B.2.2 Lifetime Cost Estimates*

Lifetime costs of treating kidney cancer were calculated using the following information:

1. the charges per phase (presented above),

2. an estimate of the average length of the maintenance phase of treatment, and

3. the percentage of patients who survive the disease.

Survival data from the National Cancer Institute (NCI) indicate that approximately 50 percent of the patients who die of kidney cancer do so within one year of diagnosis. The NCI data cover a diagnostic period from 1974 to 1981. Although survival rates have improved, the distribution of the occurrence of death is not expected to have changed substantially. This is supported by Klein et al (1993), who found that more than half of all new cases are diagnosed with regionally advanced or metastatic disease. The median survival for patients with metastatic disease is approximately ten months (Klein et al. 1993). The terminal charges are therefore assumed to occur within one year of diagnosis, on average.

It is more difficult to determine the average period of maintenance. NCI data indicate that the *average* relative survival rate is 49.8 percent at six years after diagnosis.[4] For the purposes of this analysis the average life span for a person diagnosed with kidney cancer was assumed to be six years post-diagnosis. Using this value, the average maintenance period was assumed to be 5.25 years, after adjusting for initial care and terminal care. Many patients will receive a longer or shorter period of maintenance care; however, this is a reasonable estimate based on available information. This approach is an approximation, and may be refined in the future. It is likely to underestimate medical costs due to the improved prognosis and survival duration of kidney cancer patients in recent years leading to longer periods of maintenance care.

To determine the average lifetime incremental medical costs associated with kidney cancer, the following calculations were used:

*Initial phase* costs attributable to kidney cancer were calculated using $12,608 in gross charges from Table II.4-1 minus $747 in co-morbidity charges to obtain a cost of $11,861.

[4] The relative survival rate (RSR) is an approximation of the survival rate, adjusted for background mortality. For a detailed discussion of RSR see Chapter II.2.

*Link to Chapter II.2*

*Maintenance period* charges were first calculated at $670/month from Table II.4-1 multiplied by 63 months or 5.25 years. Sixty-three months were estimated as the maintenance period based on a six-year average post-diagnosis survival, minus three months initial phase and six months terminal phase care. The average co-morbidity charges of $15,687 ($249/month multiplied by 63 months) for the maintenance phase were subtracted from the gross maintenance phase costs to obtain undiscounted annual maintenance phase charges attributable to kidney cancer of $26,523.

*Terminal costs* attributable to kidney cancer were estimated by subtracting co-morbidity charges of $1,494 from $19,302 (the gross charges for terminal care for kidney cancer patients) to obtain an incremental cost of $17,808. As noted previously, approximately 50 percent of patients with kidney cancer ultimately die of the disease. Therefore the terminal costs were multiplied by .5 to obtain an estimated average cost for this phase of $8,904.

Total Costs. Table II.4-2 shows Baker et al.'s values for the incremental medical costs for each phase. The total costs were modified by the comorbidity costs (as shown in Table II.4-1).

**Table II.4-2**
**Average Incremental Per Patient Charges in 1984 dollars (undiscounted)**

| | Incremental Costs | Total cost |
|---|---|---|
| Initial (3 months care) | $11,861 | |
| Maintenance ( 5.25 years care [a]) | $26,523 | |
| Terminal (6 months care[b]) | $8,904 | |
| | $11,861 | $47,288 |

Source: Table II.4-2, modified per text to obtain incremental charges.
[a] Six-year assumed life span minus 3 months of initial treatment and 6 months of terminal treatment.
[b] Terminal costs are incurred by only 50 percent of patients and were adjusted accordingly.

The costs shown in Table II.4-2 were used to calculate the discounted incremental per capital direct medical costs in 1996 dollars (based on the Consumer Price Index ratio (CPI-U) for medical care, 1996:1984=2.14). Both initial phase and terminal phase charges are present values because they occur in the first year post-diagnosis. Those patients who will die of kidney cancer do so, on average, within ten months of diagnosis. As noted previously, terminal charges were adjusted to reflect the fact that approximately 50 percent of patients incur terminal charges. Maintenance care is assumed to be provided over a period of 5.25 years and is discounted accordingly. (This calculation may be modified in the future as

additional information is obtained on the duration of maintenance care.) Present value maintenance phase charges are:

$26,523 using a zero percent discount rate

$24,747 using a three percent discount rate

$23,682 using a five percent discount rate

$22,702 using a seven percent discount rate

The undiscounted initial and terminal costs were summed with the various discounted maintenance care charges to obtain the total incremental per capita medical costs, as shown in Table II.4-3.

**Table II.4-3**
**Incremental Direct Medical Costs of Lifetime per Capita Treatment of Kidney Cancer in 1984 and 1996 Dollars with Various Discount Rates [a] (1996:1984 = 2.14)**

| | Present Value of Attributable Charges (Discount Rate %) | | | |
|---|---|---|---|---|
| | 0 | 3 | 5 | 7 |
| Lifetime Charges 1984 dollars | 47,288 | 45,512 | 44,417 | 43,467 |
| Lifetime Charges 1996 dollars[d] | 96,916 | 97,396 | 95,117 | 93,019 |

[a] Treatment components are discounted based on when they occur in the course of treatment. See text for discussion.
The costs presented in this chapter were current in the year the chapter was written. They can be updated using inflation factors accessible by clicking below.

*Link to inflation factors*

## II.4.B.3 Limitations

There are many limitations in cancer cost estimation. Those common to most cancers are discussed in the introductory cancer chapter: II.2.

*Link to Chapter II.2*

There are a number of limitations to the use of the Baker et al. data, many of which the authors have noted. These limitations are primarily related to the use of CMHSF (Medicare) data. First, Medicare does not cover all potential kidney cancer patients; it covers only most persons 65 and over, disabled persons entitled to Social Security cash benefits for at least 24

months, and most persons with end-stage kidney disease (Baker et al. 1991). All patients not covered by Medicare are excluded from the database, including all non-disabled people under 65 and those over 65 using private health insurance. Given that approximately half of all kidney cancer patients are under 65 (NCI 1994), the CMHSF excludes a significant number of younger patients. Approximately 95 percent of Americans 65 and over, however, are enrolled in Medicare (Baker et al. 1991).[5] Differences in medical costs incurred by senior citizens not using Medicare, or using it for only a portion of their costs, could lead to an underestimate of medical costs.

Medicare also does not cover self-administered drugs, intermediate nursing care, long-term nursing care, and expensive, extraordinary treatments (such as bone marrow transplants). For some patients these may represent significant percentages of their total treatment costs. To the extent that 1) younger patients receive more aggressive (and therefore more expensive) medical treatment for kidney cancer and 2) Medicare beneficiaries use medical care not covered by Medicare, the values in the CMHSF database will underestimate medical costs.

A minor drawback of the Baker et al. data is due to the researchers' inability to identify cancer patients in CMHSF whose diagnosis and first course of therapy did not involve hospitalization. For most kidney cancer patients the first course of therapy involves major surgery. Consequently, the omission of non-hospitalized patients is likely to result in a negligible underestimate of medical costs.

The reliability of the data contained in the CMHSF database varies. An independent analysis of CMHSF performed in 1977 by the Institute of Medicine of the National Academy of Sciences found that the frequency of discrepancies in principal diagnoses varied among diseases (Baker et al., 1991). It is unclear whether the presence of misnamed diagnoses contained in CMHSF potentially increase or decrease the resultant cost estimates.

Since Baker et al. include only those costs *after* the initial diagnosis, they omit costs associated with prediagnostic tests and treatment. Although these costs could be significant, substantial medical treatment (e.g., tests requiring hospitalization) would also likely result in a diagnosis and thus be included in Baker et al.'s analysis. This omission likely causes the values generated by Baker et al. to somewhat underestimate direct medical costs from the treatment of kidney cancer.

Another limitation to using the Baker data is its age. The most recent data used by Baker is more than a decade old. Although many aspects of

[5] This figure represents those enrolled in Medicare Part A; 95 percent of those enrolled in Medicare Part A choose also to enroll in Medicare Part B.

treatment have remained constant, new diagnostic methods and treatments such as immunotherapy have potentially increased lifetime treatment costs. Improved diagnostic procedures such as CT scans, ultrasonography, and MRI (McCredie 1994) have led to earlier diagnoses and treatment. The lack of data on new treatment methods may cause costs to be underestimated.

Age of the data is also a problem with regard to survival statistics. NCI maintains current survival information, but the survival prospects for a patient diagnosed now are better than in previous decades. Since long-term survival can only be evaluated retrospectively, there is uncertainty in estimations of survival for current patients based on past survival patterns.

An additional limitation of this analysis is that medical costs incurred as a result of kidney cancer, but not considered by Baker et al., may arise as a result of treatment for kidney cancer. Secondary cancers and other adverse health effects may occur due to radiation, chemotherapy treatment, and other therapies. These effects may occur substantially after the cancer treatment has been completed and can incur added medical costs not considered in this chapter.

One limitation of the cost estimates that is directly related to the analytical method used in this chapter is the lack of a yearly sequential analysis of costs. A more precise method for estimating direct medical costs would include year-to-year information on treatment and survival, with costs determined using an estimate of the proportion of patients surviving each year and those who died due to natural causes or kidney cancer. When this chapter was developed, that method was not yet in use for this handbook. (See Chapter III.2 for a more complete discussion of the new method.) Average durations of treatment and survival were used in this analysis and are likely to provide a good approximation of the costs that would be obtained through a more detailed and complex analysis.

*Link to Chapter II.2*

## II.4.C. Conclusions

Overall, despite the limitations described above, Baker's analysis of the CMHSF data represents the most nationally-representative per-patient lifetime estimate of the direct medical costs of treating kidney cancer available. Their cost estimates are based on sound criteria and reasonably current data, since the treatment of kidney cancer has not changed substantially since Baker et al.'s analysis. The authors have made adjustments for many of the factors that can be quantitatively modified (e.g., Medicare's underpayment for services).

Because more of the uncertainties in their analysis appear to underestimate costs (e.g., population covered, changes in treatment, and omission of pre-diagnostic costs), the net result is a likely underestimation of actual direct medical costs. This tendency toward underestimation can be noted when using the cost estimates in this chapter in a benefits assessment.